# Impulse-Momentum Theorem

Impulse = Momentum

$\Delta t = t_f - t_i$

$$\bar{F}\Delta t = m\Delta\bar{v}$$

$$\bar{F} = m\left(\frac{\Delta\bar{v}}{\Delta t}\right) \quad \frac{\Delta\bar{v}}{\Delta t} = \bar{a}$$

$$\bar{F} = m\bar{a}$$

$\bar{F}_A \rightarrow$ applied force

there is no such thing as "force acceleration"

Balanced forces → velocity does NOT change, so there is NO acceleration

$$\bar{F}_{net} = \emptyset$$

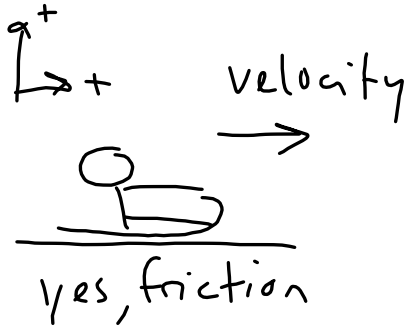
$$[\Sigma \bar{F} = \emptyset]$$

Unbalanced forces → there is acceleration

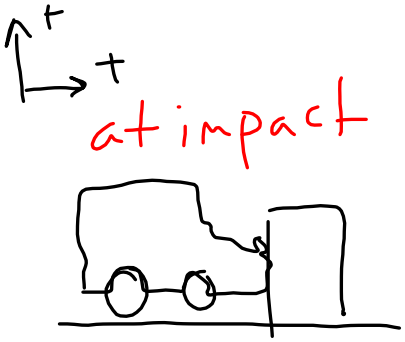
$$\bar{F}_{net} = m\bar{a}$$

$$[\Sigma \bar{F} = m\bar{a}]$$

Picture:



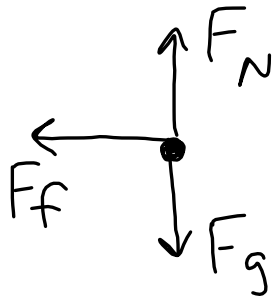

- just draw what is happening
- forces not needed



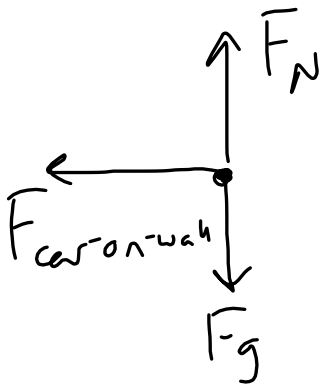

at impact

- just looking at the car

FBD:




- start with a dot
- force arrows point away from dot
- label arrows with letters



# Multi-Step Problems:

1) $D = \frac{m}{V}$

$m = DV$

$= (0.93\ g/cm^3)(185\ cm^3)$

$= 172.05\ g$

$= 0.17205\ kg$

$D = 0.93\ g/cm^3$

$V = 185\ cm^3$

$F = 9.5\ N$

$a = ?$

$m =$ _____
find first

$F = ma$

$a = \frac{F}{m}$

$= \frac{9.5\ N}{0.17205\ kg}$

$= 55.22\ m/s^2$

$F = ma$

$a = \frac{F}{m}$

$= \frac{F}{DV}$

$D = \frac{m}{V}$

$m = DV$

3) $F = ma$

$a = 170\ m/s^2$

$F = 25\ N$

$V = 219\ cm^3$

$D = ?$

$m = \_\_\_\_$

$m = \frac{F}{a}$

$= \frac{25\ N}{170\ m/s^2}$

$= 0.147\ kg$

$= 147\ g$

$D = \frac{m}{V}$

$= \frac{147\ g}{219\ cm^3}$

$= 0.68\ g/cm^3$

5)

$F_g = m a_g$

$m = \frac{F_g}{a_g}$

$= \frac{54\ N}{9.8\ m/s^2}$

$= 5.51\ kg$

$F_g = 54\ N$

$t = 11\ s$

$d = 35\ m$

$p = ?$

$m =$ ____

$v =$ ____

$v = \frac{d}{t}$

$= \frac{35\ m}{11\ s}$

$= 3.18\ m/s$

$p = mv$

$= (5.51\ kg)(3.18\ m/s)$

$= 17.52\ kg \cdot m/s$

6) $a = \frac{v_f - v_i}{t}$

$\frac{18\ m/s - 0\ m/s}{22\ s}$

$8.2\ m/s^2$

$V = 5192\ cm^3$

$D = ?$

$m = \_\_\_\_$

$F = 75\ N$

$a = \_\_\_\_$

$F = ma$

$m = \frac{F}{a}$

$= \frac{75\ N}{0.82\ m/s^2}$

$= 91.5\ kg$

$= 91500\ g$

$D = \frac{91500\ g}{5192\ cm^3}$

$= 17.62\ g/cm^3$